NON-EQUILIBRIUM PRESOLAR CONDENSATES IN PRIMITIVE METEORITES. M. Bose, C. Floss, and F. J. Stadermann. Laboratory for Space Sciences and Physics Department, Washington University, St. Louis, MO 63130. E-mail: mbose@physics.wustl.edu.

Introduction: The compositions of dust grains forming in O-rich environments under equilibrium conditions are well understood, predicting the formation of abundant (Mg-rich) forsterite and enstatite as well as some Fe metal [1]. However, elemental characterization of presolar silicate grains identified in primitive meteorites has shown that the majority of the grains are Fe-rich [e.g., 2, 3]. This is most likely due to their formation in dynamic stellar environments, where equilibrium conditions are not maintained. In addition, presolar SiO_2 grains have recently been identified in meteorites [2, 4, 5]; SiO_2 grains have been dubbed "mythical condensates" [1], and can only condense under non-equilibrium conditions [6].

Auger characterization has shown that many presolar silicates have non-stoichiometric elemental compositions [2, 3] and TEM work suggests that at least some presolar silicates are amorphous aggregates with variable compositions [e.g., 7]. Here we present data for additional presolar silicates identified in the ALHA77307 CO3.0 chondrite and explore the possible origins of these grains.

Results and Discussion: Seventy-eight O-anomalous grains were identified in the ALHA77307 matrix. Elemental characterization of 46 of these grains shows that 43 exhibit non-stoichiometric silicate grain compositions. More than half of the grains have compositions intermediate between olivine and pyroxene; more than half are also Fe-rich, although a significant fraction do have Mg-rich compositions.

We also found two composite grains in ALHA77307. One of these consists of two silicate sub-grains with different elemental compositions; the oxygen isotopic composition is uniformly ^{17}O-rich over both sub-grains. The other one consists of a number of ~50–70 nm sized sub-grains that co-exist as a loose aggregate; elemental spectra indicate that some of the sub-grains are Ca-rich. Some heterogeneity appears to be present in the O isotopic composition of this composite grain, but it is not clear if the variations are statistically significant. Finally, we have also found a Mg-oxide grain in ALHA77307. Comparison to a periclase standard indicates that the Mg/O ratio of the grain is 1.0±0.1. This is the first reported occurrence of this grain type in the presolar grain inventory.

Extensive study of presolar graphite and SiC has shown that equilibrium condensation models adequately explain the formation of these grains [e.g., 8]. In contrast, the presence of large numbers of non-stoichiometric grains in the presolar silicate inventory suggests that condensation of presolar silicates more often occurred under non-equilibrium conditions. We will discuss possible scenarios for the formation of these grains. In addition, we will evaluate the conditions under which the composite grains found in ALHA77307 may have formed.

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